

MEDIUM CURRENT
1.2 TO 37V ADJUSTABLE VOLTAGE REGULATOR

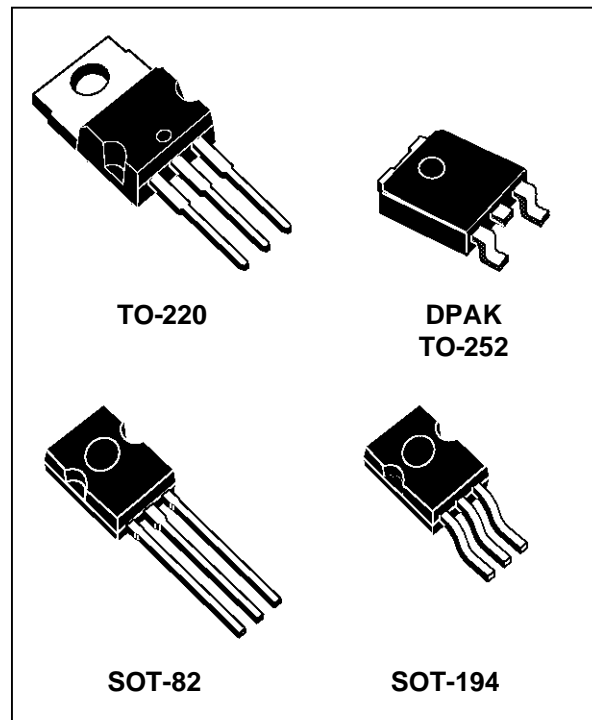
- OUTPUT VOLTAGE RANGE : 1.2 TO 37V
- OUTPUT CURRENT IN EXCESS OF 500 mA
- LINE REGULATION TYP. 0.01%
- LOAD REGULATION TYP. 0.1%
- THERMAL OVERLOAD PROTECTION
- SHORT CIRCUIT PROTECTION
- OUTPUT TRANSISTOR SAFE AREA COMPENSATION
- FLOATING OPERATION FOR HIGH VOLTAGE APPLICATIONS

DESCRIPTION

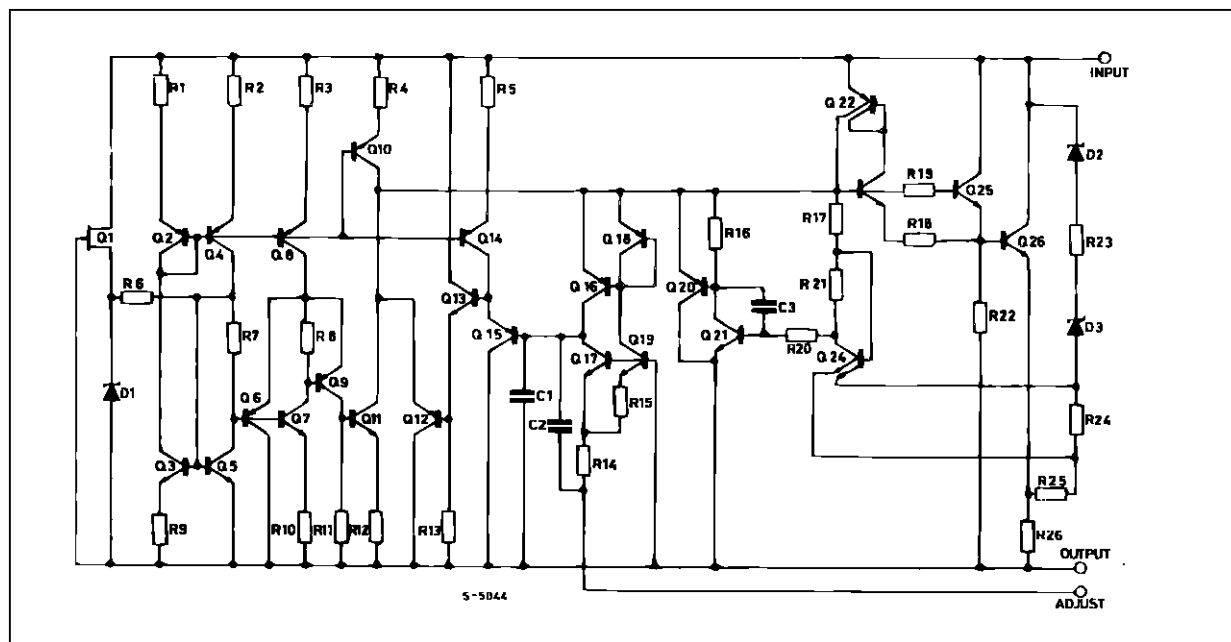
The LM217M/LM317M are monolithic integrated circuits in TO-220, DPAK, SOT-82 and SOT-194 packages intended for use as positive adjustable voltage regulators.

They are designed to supply until 500 mA of load current with an output voltage adjustable over a 1.2 to 37V range.

The nominal output voltage is selected by means of only a resistive divider, making the device exceptionally easy to use and eliminating the stocking of many fixed regulators.



SCHEMATIC DIAGRAM



LM217M/LM317M

ABSOLUTE MAXIMUM RATINGS

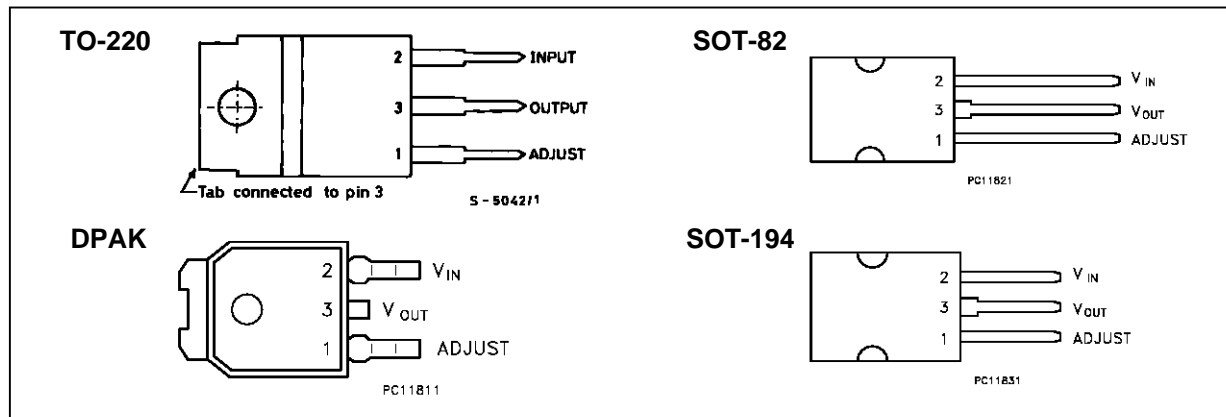
| Symbol | Parameter | Value | Unit |
|-------------|---|------------------------|----------|
| $V_i - V_o$ | Input-Output Differential Voltage | 40 | V |
| P_d | Power Dissipation | Internally Limited | |
| T_{opr} | Operating Junction Temperature Range (*) for LM217M for LM317M | -40 to 125 0 to 125 | °C °C |
| T_{stg} | Storage Temperature Range | -55 to 150 | °C |

(*) Re-Boot is not guaranteed for $T_j \geq 85^\circ\text{C}$

THERMAL DATA

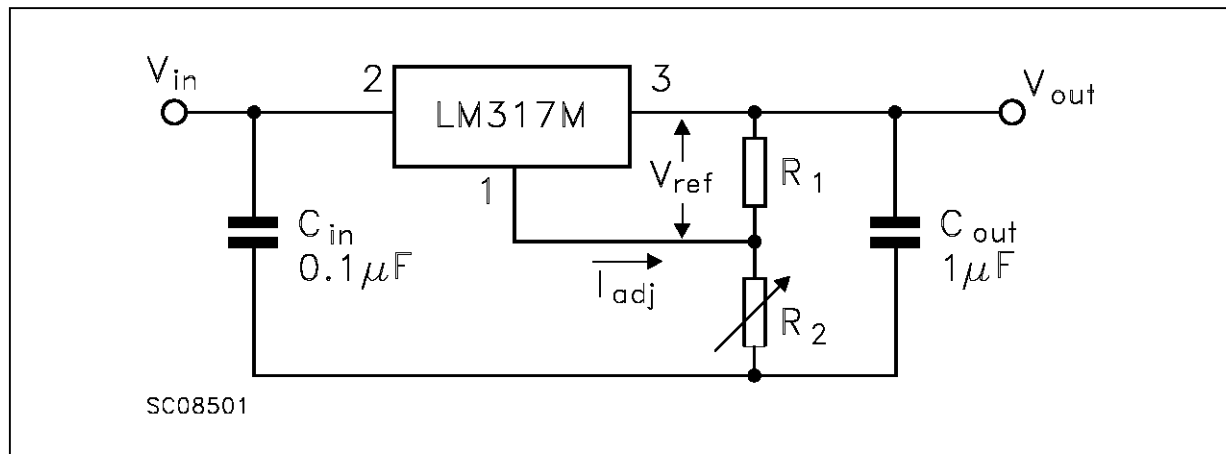
| Symbol | Parameter | | SOT-82 SOT-194 DPAK | TO-220 | Unit |
|----------------|-------------------------------------|-----|---------------------------|--------|------|
| $R_{thj-case}$ | Thermal Resistance Junction-case | Max | 8 | 3 | °C/W |
| $R_{thj-amb}$ | Thermal Resistance Junction-ambient | Max | 100 | 50 | °C/W |

PIN CONNECTION AND ORDERING NUMBERS



| Type | TO-220 | DPAK | SOT-82 | SOT-194 |
|--------|---------|----------|---------|---------|
| LM217M | LM217MT | LM217MDT | LM217MX | LM217MS |
| LM317M | LM317MT | LM317MDT | LM317MX | LM317MS |

TEST CIRCUIT



ELECTRICAL CHARACTERISTICS FOR LM217M (Refer to the test circuits, $-40 \leq T_j \leq 125^\circ\text{C}$
 $V_i - V_o = 5\text{ V}$, $I_o = 100\text{ mA}$, $P_d \leq 7.5\text{ W}$, unless otherwise specified)

| Symbol | Parameter | Test Conditions | | Min. | Typ. | Max. | Unit |
|--------------------------|---|---|---------------------------|------|-------------|---------------|------------------|
| ΔV_o | Line Regulation | $V_i - V_o = 3\text{ to }40\text{ V}$ | $T_j = 25^\circ\text{C}$ | | 0.01 | 0.02 | %/V |
| | | | | | 0.02 | 0.05 | %/V |
| ΔV_o | Load Regulation | $V_o \leq 5\text{ V}$ $I_o = 10\text{ mA to }500\text{ mA}$ | $T_j = 25^\circ\text{C}$ | | 5 | 15 | mV |
| | | | | | 20 | 50 | mV |
| | | $V_o \geq 5\text{ V}$ $I_o = 10\text{ mA to }500\text{ mA}$ | $T_j = 25^\circ\text{C}$ | | 0.1 | 0.3 | %/V _o |
| | | | | | 0.3 | 1 | %/V _o |
| I_{ADJ} | Adjustment Pin Current | | | 50 | 100 | μA | |
| ΔI_{ADJ} | Adjustment Pin Current | $V_i - V_o = 3\text{ to }40\text{ V}$ $I_o = 10\text{ mA to }500\text{ mA}$ | | | 0.2 | 5 | μA |
| V_{REF} | Reference Voltage | $V_i - V_o = 3\text{ to }40\text{ V}$ $I_o = 10\text{ mA to }500\text{ mA}$ | | 1.2 | 1.25 | 1.3 | V |
| $\frac{\Delta V_o}{V_o}$ | Output Voltage Temperature Stability | | | | 0.7 | | % |
| $I_{o(min)}$ | Minimum Load Current | $V_i - V_o = 40\text{ V}$ | | | 3.5 | 5 | mA |
| $I_{o(max)}$ | Maximum Output Current | $V_i - V_o \leq 15\text{ V}$ $V_i - V_o = 40\text{ V}$, $P_d < P_{dMAX}$, $T_j = 25^\circ\text{C}$ | | 500 | 1000 200 | | mA |
| e_N | Output Noise Voltage (percentage of V_o) | $B = 10\text{ Hz to }10\text{ KHz}$ $T_j = 25^\circ\text{C}$ | | | 0.003 | | % |
| SVR | Supply Voltage Rejection (*) | $T_j = 25^\circ\text{C}$ $f = 120\text{ Hz}$ | $C_{ADJ} = 0$ | | 65 | | dB |
| | | | $C_{ADJ} = 10\mu\text{F}$ | 66 | 80 | | dB |

(*) CADJ is connected between Adjust pin and Ground.

ELECTRICAL CHARACTERISTICS FOR LM317M (Refer to the test circuits, $0 \leq T_j \leq 125^\circ\text{C}$
 $V_i - V_o = 5\text{ V}$, $I_o = 100\text{ mA}$, $P_d \leq 7.5\text{ W}$, unless otherwise specified)

| Symbol | Parameter | Test Conditions | | Min. | Typ. | Max. | Unit |
|--------------------------|---|---|---------------------------|------|-------------|---------------|------------------|
| ΔV_o | Line Regulation | $V_i - V_o = 3\text{ to }40\text{ V}$ | $T_j = 25^\circ\text{C}$ | | 0.01 | 0.04 | %/V |
| | | | | | 0.02 | 0.07 | %/V |
| ΔV_o | Load Regulation | $V_o \leq 5\text{ V}$ $I_o = 10\text{ mA to }500\text{ mA}$ | $T_j = 25^\circ\text{C}$ | | 5 | 25 | mV |
| | | | | | 20 | 70 | mV |
| | | $V_o \geq 5\text{ V}$ $I_o = 10\text{ mA to }500\text{ mA}$ | $T_j = 25^\circ\text{C}$ | | 0.1 | 0.5 | %/V _o |
| | | | | | 0.3 | 1.5 | %/V _o |
| I_{ADJ} | Adjustment Pin Current | | | 50 | 100 | μA | |
| ΔI_{ADJ} | Adjustment Pin Current | $V_i - V_o = 3\text{ to }40\text{ V}$ $I_o = 10\text{ mA to }500\text{ mA}$ | | | 0.2 | 5 | μA |
| V_{REF} | Reference Voltage | $V_i - V_o = 3\text{ to }40\text{ V}$ $I_o = 10\text{ mA to }500\text{ mA}$ | | 1.2 | 1.25 | 1.3 | V |
| $\frac{\Delta V_o}{V_o}$ | Output Voltage Temperature Stability | | | | 0.7 | | % |
| $I_{o(min)}$ | Minimum Load Current | $V_i - V_o = 40\text{ V}$ | | | 3.5 | 10 | mA |
| $I_{o(max)}$ | Maximum Output Current | $V_i - V_o \leq 15\text{ V}$ $V_i - V_o = 40\text{ V}$, $P_d < P_{dMAX}$, $T_j = 25^\circ\text{C}$ | | 500 | 1000 200 | | mA |
| e_N | Output Noise Voltage (percentage of V_o) | $B = 10\text{ Hz to }10\text{ KHz}$ $T_j = 25^\circ\text{C}$ | | | 0.003 | | % |
| SVR | Supply Voltage Rejection (*) | $T_j = 25^\circ\text{C}$ $f = 120\text{ Hz}$ | $C_{ADJ} = 0$ | | 65 | | dB |
| | | | $C_{ADJ} = 10\mu\text{F}$ | 66 | 80 | | dB |

(*) CADJ is connected between Adjust pin and Ground.

Figure 1 : Current Limit

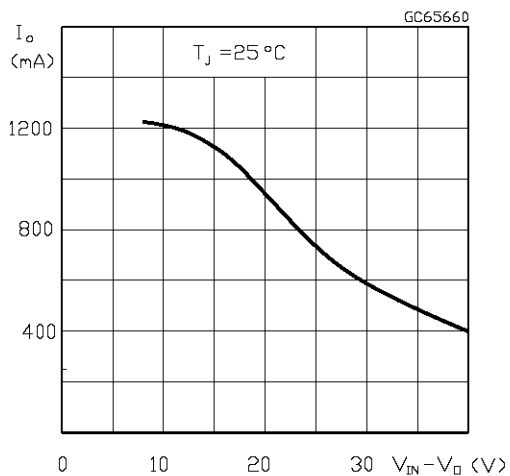


Figure 2 : Minimum Operating Current

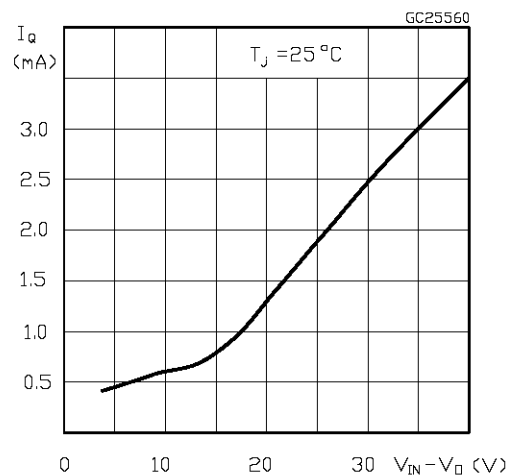


Figure 3 : Basic Adjustable Regulator.

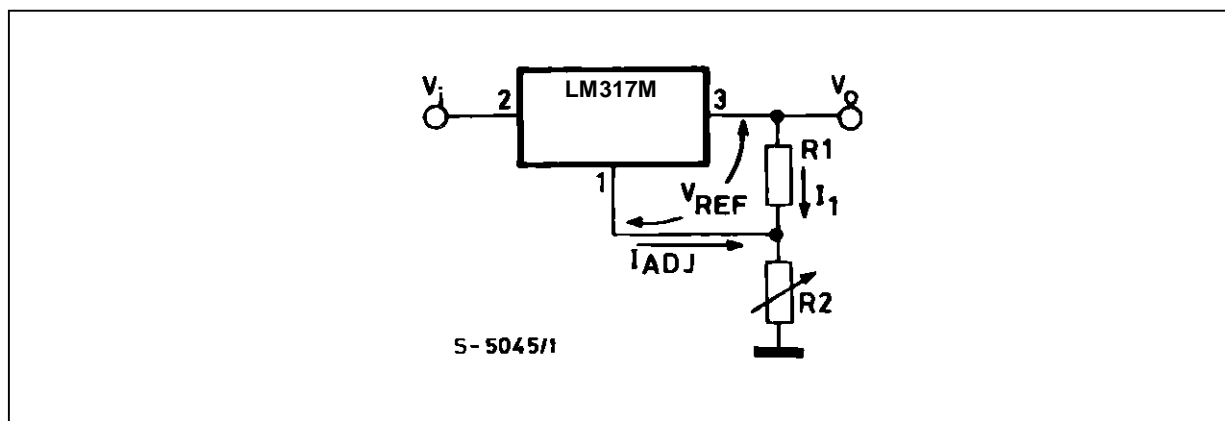
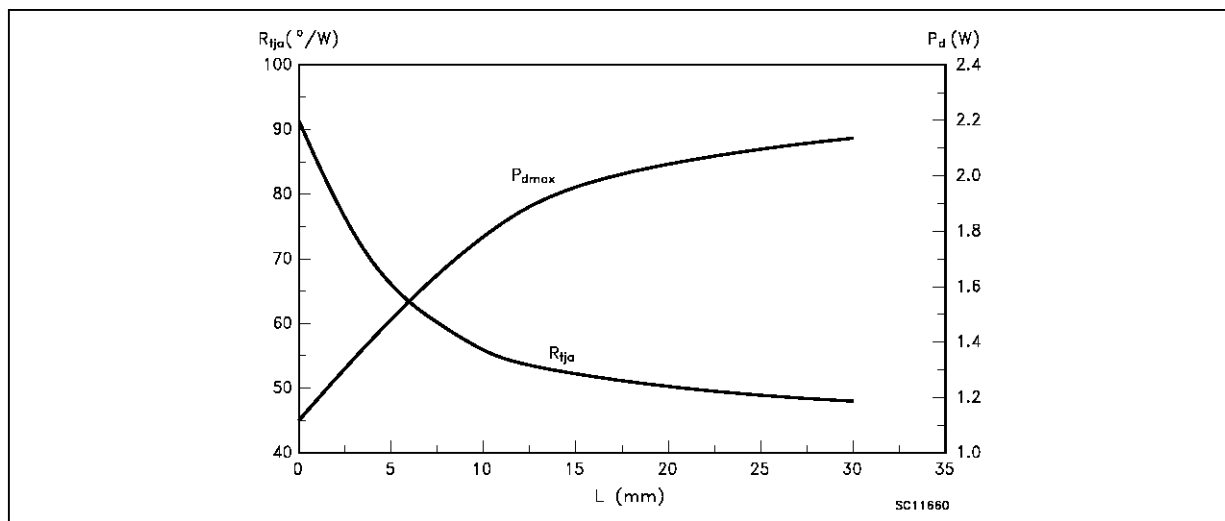


Figure 4 : Thermal Resistance & Maximum Power Dissipation vs P.C.B. Copper Length for DPAK



P_{dmax} calculated for $T_a = 50^\circ\text{C}$

APPLICATION INFORMATION

The LM317M provides an internal reference voltage of 1.25V between the output and adjustments terminals. This is used to set a constant current flow across an external resistor divider (see fig. 3), giving an output voltage V_O of:

$$V_O = V_{REF} \left(1 + \frac{R_2}{R_1}\right) + I_{ADJ} R_2$$

The device was designed to minimize the term I_{ADJ} (100 μ A max) and to maintain it very constant with line and load changes. Usually, the error term $I_{ADJ}R_2$ can be neglected. To obtain the previous requirement, all the regulator quiescent current is returned to the output terminal, imposing a minimum load current condition. If the load is insufficient, the output voltage will rise.

Since the LM317M is a floating regulator and "sees" only the input-to-output differential voltage, supplies of very high voltage with respect to ground can be regulated as long as the maximum input-to-output differential is not exceeded. Furthermore, programmable regulator are easily obtainable and, by connecting a fixed resistor between the adjustment and output, the device can be used as a precision current regulator.

In order to optimise the load regulation, the current set resistor R_1 (see fig. 3) should be tied as close as possible to the regulator, while the ground terminal of R_2 should be near the ground of the load to provide remote ground sensing.

EXTERNAL CAPACITORS (Fig.5)

Normally no capacitors are needed unless the device is situated far from the input filter capacitors; in which case an input bypass is needed.

A 0.1 μ F disc or 1 μ F tantalium input bypass capacitor (C_i) is recommended to reduce the sensitivity to input line impedance.

The adjustment terminal may be bypassed to ground to improve ripple rejection. This capacitor (C_{adj}) prevents ripple from being amplified as the output voltage is increased. A 10 μ F capacitor should improve ripple rejection about 80dB at 120Hz in a 10V application.

Although the LM317M is stable with no output capacitance like any feedback circuit, certain values of external capacitance can cause excessive ringing. An output capacitance (C_o) in the form of a 1 μ F tantalium or 25 μ F aluminium electrolytic capacitor on the output swamps this effect and insures stability.

PROTECTION DIODES (Fig.5)

When external capacitors are used with any IC regulator it is sometimes necessary to add protection diodes to prevent the capacitors from discharging through low current points into the regulator.

Figure 5 show the LM317M with the recommended protection diodes for output voltages in excess of 25V or high capacitance values ($C_3 > 25\mu$ F, $C_2 > 10\mu$ F). Diode D1 prevents C_3 from discharging through the IC during an input short-circuit. The combination of diodes D1 and D2 prevents C_2 from discharging through the regulator during an input or output short-circuit.

START-UP BLOCK

It's not guaranteed the Re-Boot of the device when the junction temperature is over 85 °C.

Figure 5 : Voltage Regulator with Protection Diodes.

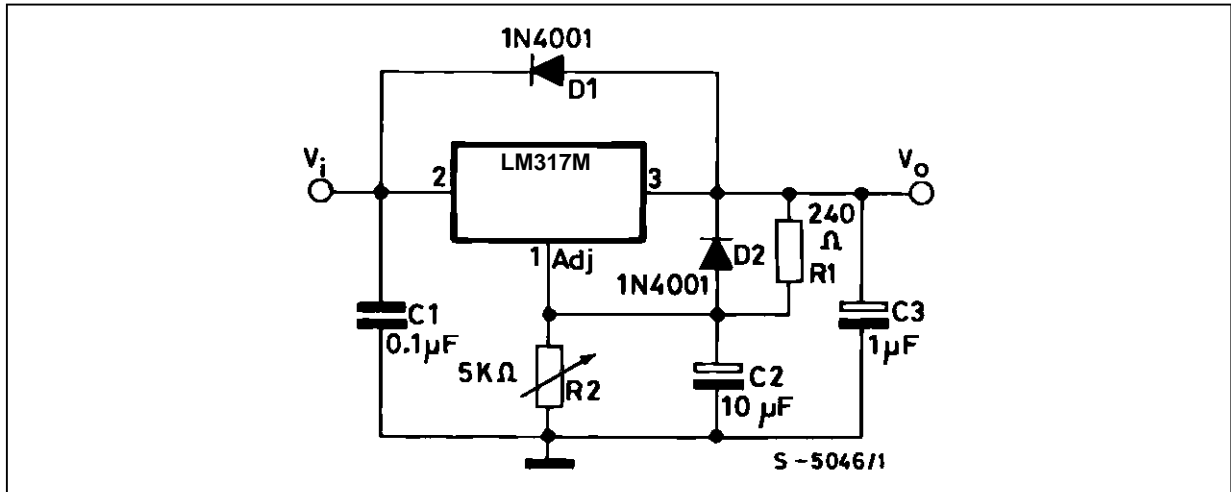


Figure 6 : Slow Turn-on 15V Regulator.

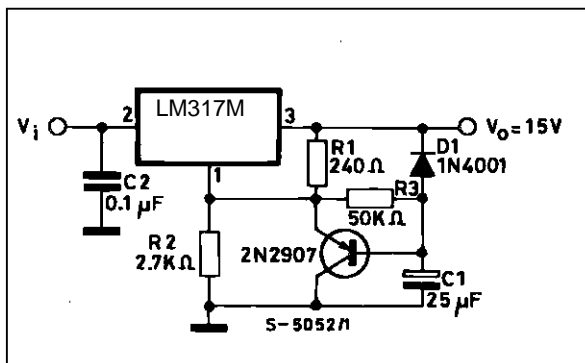


Figure 7 : Current Regulator.

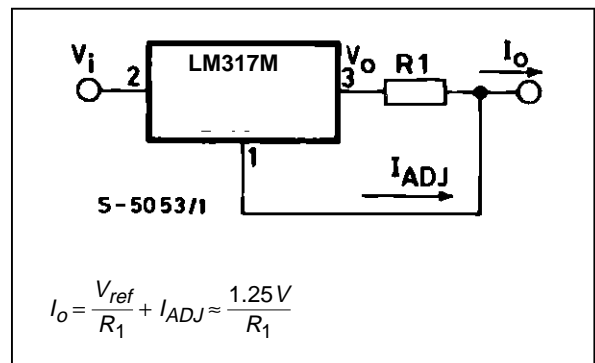


Figure 8 : 5V Electronic Shut-down Regulator.

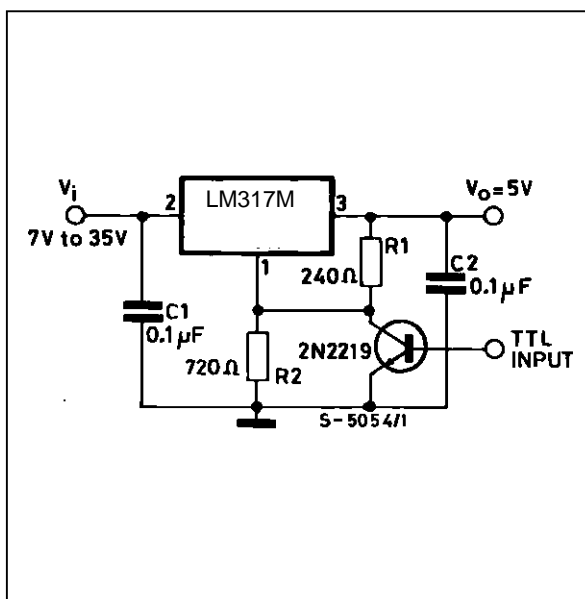
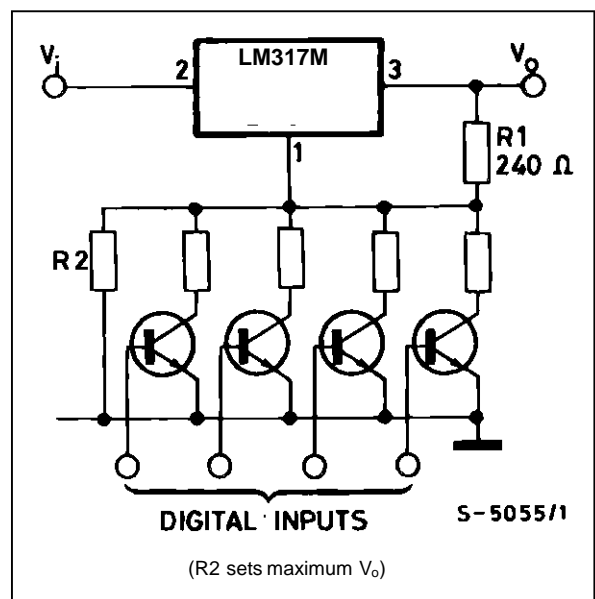
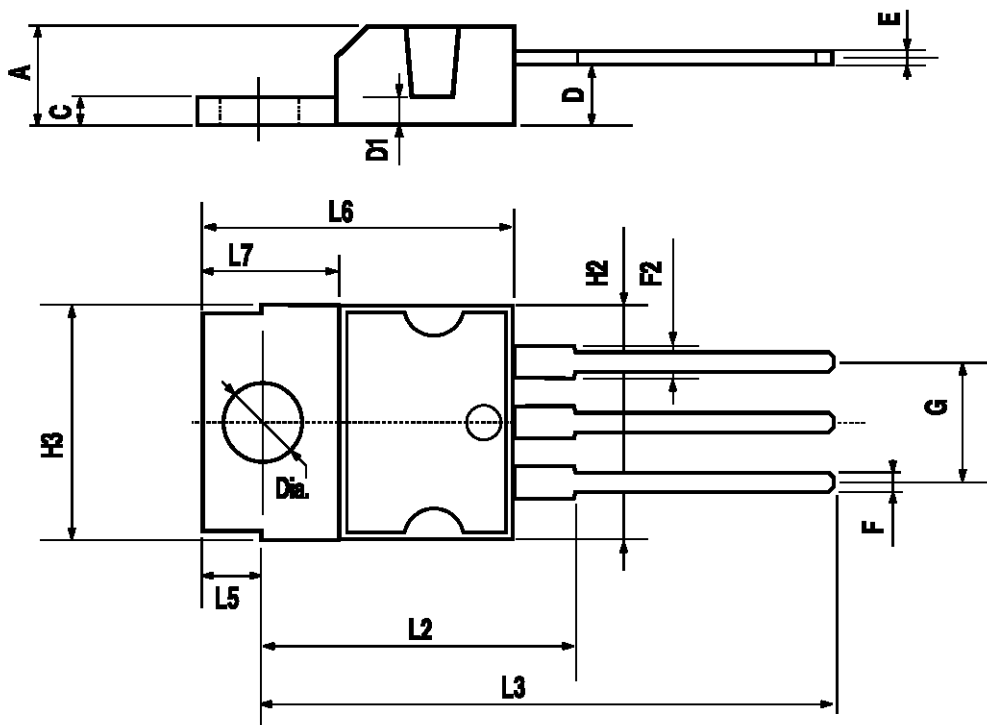


Figure 9 : Digitally Selected Outputs.



TO-220 MECHANICAL DATA

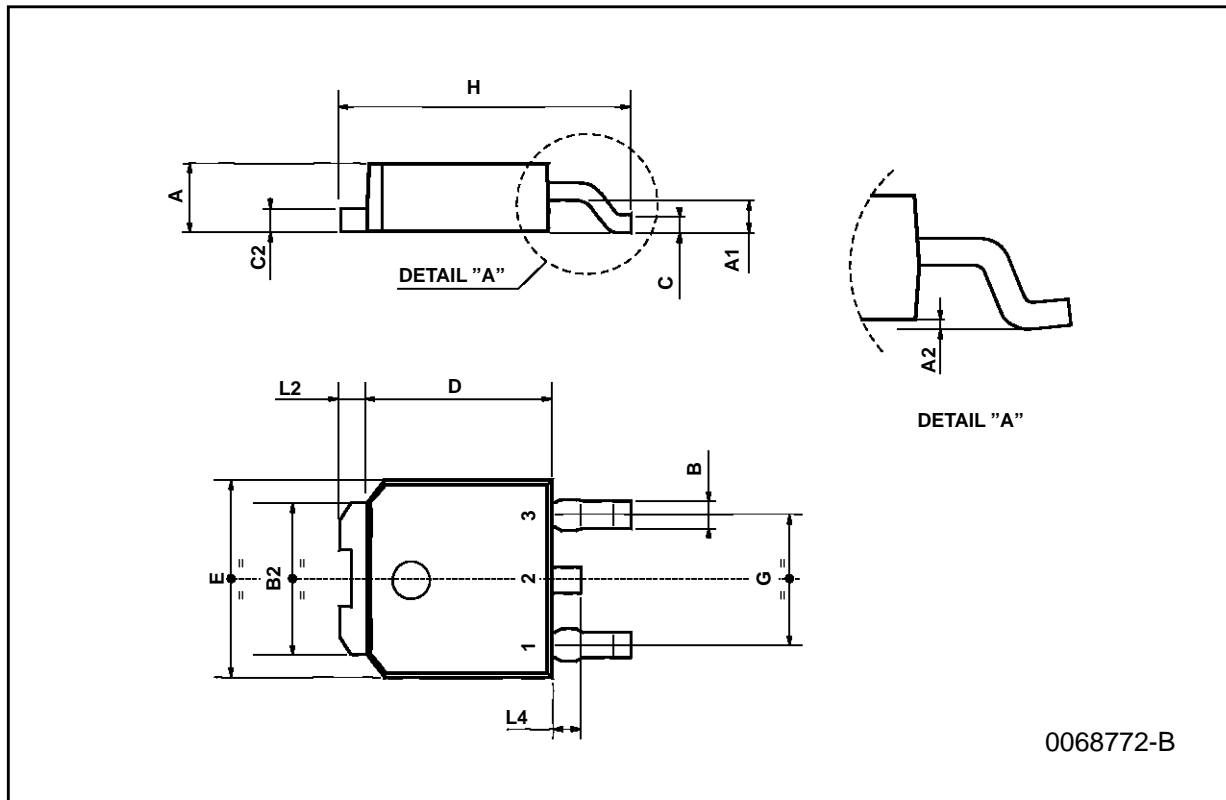
| DIM. | mm | | | inch | | |
|------|-------|------|------|-------|-------|-------|
| | MIN. | TYP. | MAX. | MIN. | TYP. | MAX. |
| A | | | 4.8 | | | 0.189 |
| C | | | 1.37 | | | 0.054 |
| D | 2.4 | | 2.8 | 0.094 | | 0.110 |
| D1 | 1.2 | | 1.35 | 0.047 | | 0.053 |
| E | 0.35 | | 0.55 | 0.014 | | 0.022 |
| F | 0.61 | | 0.94 | 0.024 | | 0.037 |
| F2 | 1.15 | | 1.4 | 0.045 | | 0.055 |
| G | 4.95 | 5.08 | 5.21 | 0.195 | 0.200 | 0.205 |
| H2 | | | 10.4 | | | 0.409 |
| H3 | 10.05 | | 10.4 | 0.396 | | 0.409 |
| L2 | | 16.2 | | | 0.638 | |
| L3 | 26.3 | 26.7 | 27.1 | 1.035 | 1.051 | 1.067 |
| L5 | 2.6 | | 3 | 0.102 | | 0.118 |
| L6 | 15.1 | | 15.8 | 0.594 | | 0.622 |
| L7 | 6 | | 6.6 | 0.236 | | 0.260 |
| Dia. | 3.65 | | 3.85 | 0.144 | | 0.152 |



P011D

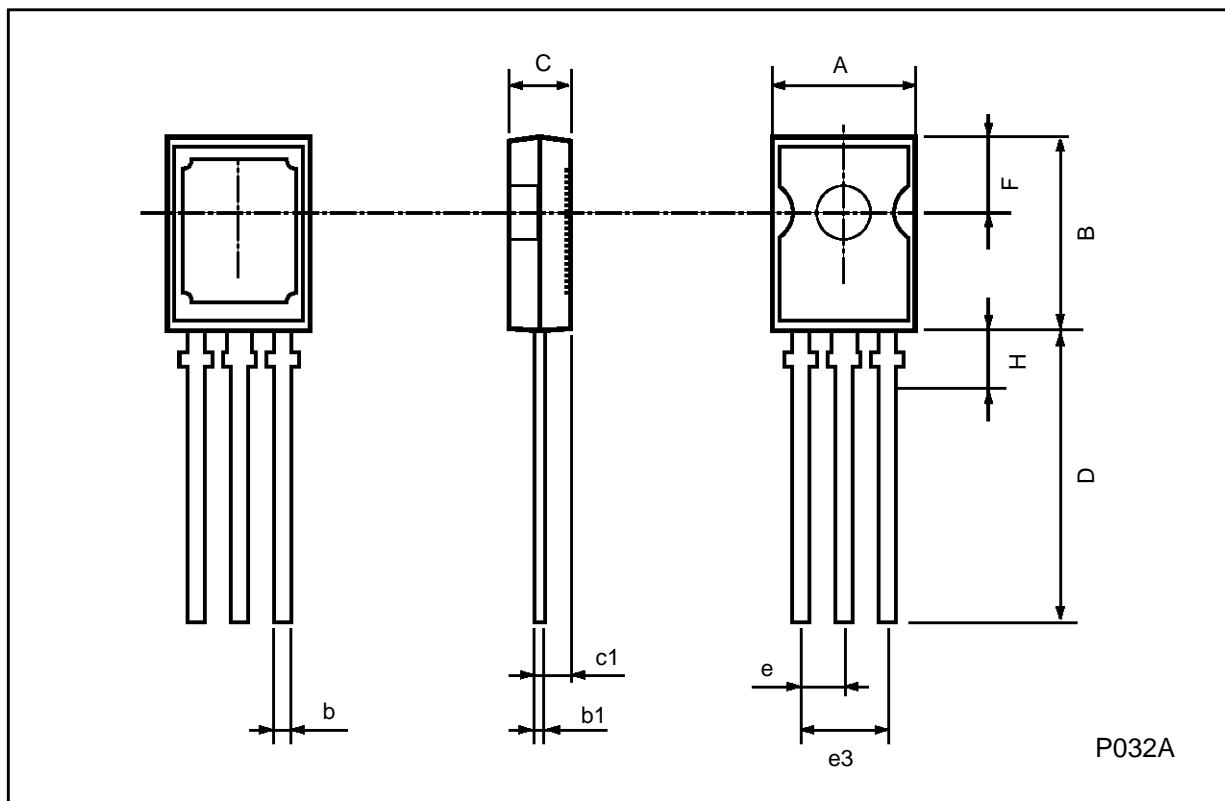
TO-252 (DPAK) MECHANICAL DATA

| DIM. | mm | | | inch | | |
|------|------|------|------|-------|-------|-------|
| | MIN. | TYP. | MAX. | MIN. | TYP. | MAX. |
| A | 2.2 | | 2.4 | 0.086 | | 0.094 |
| A1 | 0.9 | | 1.1 | 0.035 | | 0.043 |
| A2 | 0.03 | | 0.23 | 0.001 | | 0.009 |
| B | 0.64 | | 0.9 | 0.025 | | 0.035 |
| B2 | 5.2 | | 5.4 | 0.204 | | 0.212 |
| C | 0.45 | | 0.6 | 0.017 | | 0.023 |
| C2 | 0.48 | | 0.6 | 0.019 | | 0.023 |
| D | 6 | | 6.2 | 0.236 | | 0.244 |
| E | 6.4 | | 6.6 | 0.252 | | 0.260 |
| G | 4.4 | | 4.6 | 0.173 | | 0.181 |
| H | 9.35 | | 10.1 | 0.368 | | 0.397 |
| L2 | | 0.8 | | | 0.031 | |
| L4 | 0.6 | | 1 | 0.023 | | 0.039 |



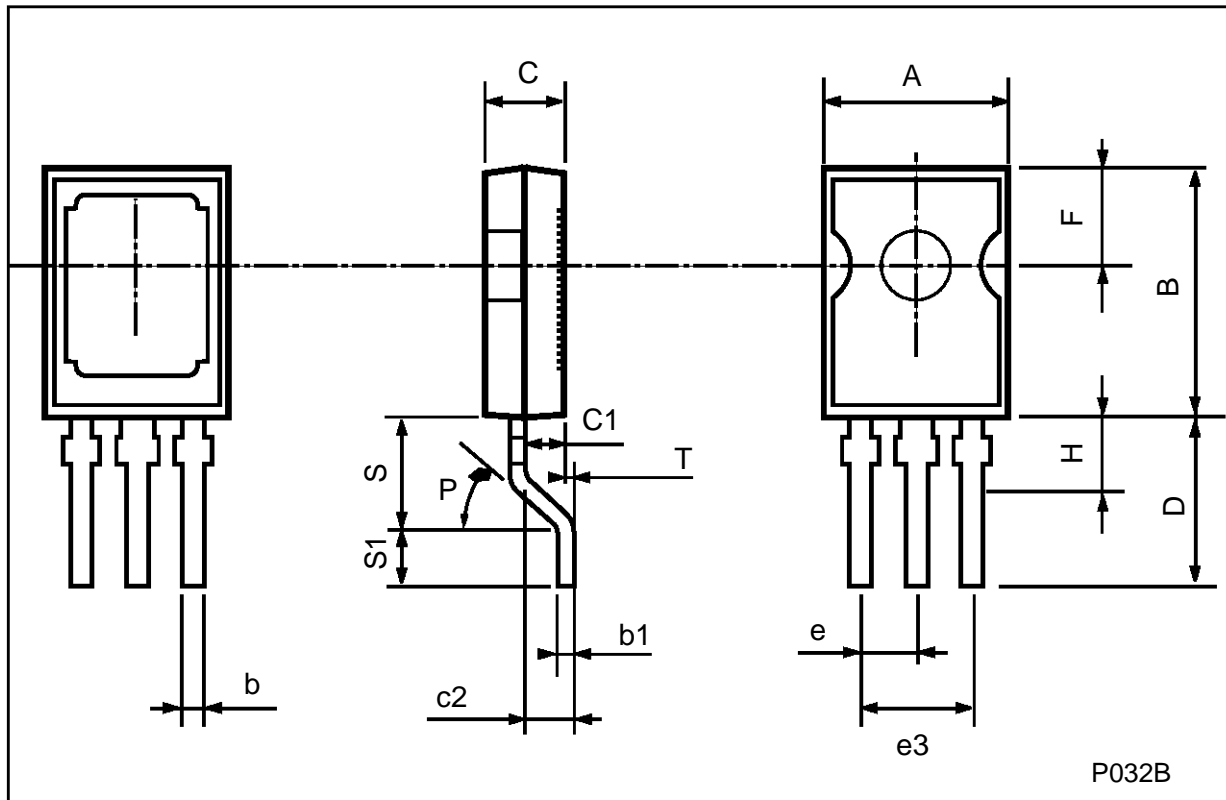
SOT-82 MECHANICAL DATA

| DIM. | mm | | | inch | | |
|------|------|------|------|-------|-------|-------|
| | MIN. | TYP. | MAX. | MIN. | TYP. | MAX. |
| A | 7.4 | | 7.8 | 0.291 | | 0.307 |
| B | 10.5 | | 11.3 | 0.413 | | 0.445 |
| b | 0.7 | | 0.9 | 0.028 | | 0.035 |
| b1 | 0.49 | | 0.75 | 0.019 | | 0.030 |
| C | 2.4 | | 2.7 | 0.04 | | 0.106 |
| c1 | | 1.2 | | | 0.047 | |
| D | | 15.7 | | | 0.618 | |
| e | | 2.2 | | | 0.087 | |
| e3 | | 4.4 | | | 0.173 | |
| F | | 3.8 | | | 0.150 | |
| H | | | 2.54 | | 0.100 | |



SOT-194 MECHANICAL DATA

| DIM. | mm | | | inch | | |
|------|-----------|------|------|-------|-------|-------|
| | MIN. | TYP. | MAX. | MIN. | TYP. | MAX. |
| A | 7.4 | | 7.8 | 0.291 | | 0.307 |
| B | 10.5 | | 11.3 | 0.413 | | 0.445 |
| b | 0.7 | | 0.9 | 0.028 | | 0.035 |
| b1 | 0.49 | | 0.75 | 0.019 | | 0.030 |
| C | 2.4 | | 2.7 | 0.094 | | 0.106 |
| c1 | | 1.2 | | | 0.047 | |
| c2 | | 1.3 | | | 0.051 | |
| D | | 6 | | | 0.236 | |
| e | | 2.2 | | | 0.087 | |
| e3 | | 4.4 | | | 0.173 | |
| F | | 3.8 | | | 0.150 | |
| H | | | 2.54 | | | 0.100 |
| P | 45 (typ.) | | | | | |
| S | | 4 | | | 0.157 | |
| S1 | | 2 | | | 0.079 | |
| T | | 0.1 | | | 0.004 | |



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